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birds of the high Valley are essentially aerial; they show a greater development of wings over legs; climbers, scratchers, runners, waders and swimmers are few. There is less brilliant plumage than in lower, warmer altitudes. Green and brown are the prevailing colors. Even the hummers are surpassed by those on the Pacific slope, in the Valley of the Magdalena and along the coast to Rio. All of the Trochilidæ belong to the group *Polytminae*; the "Hermit" hummers keep to the dense forests. Leaving out the *Docimaster* (which properly belong to Nanegal on the west slope), the average length of the bills of Quitonian hummers is three-fourths of an inch. Their nests are covered with moss; never with lichens. The finches nidify in October; the condors in February; the hummers in April.

THE GENUS HYSTERIUM AND SOME OF ITS ALLIES.

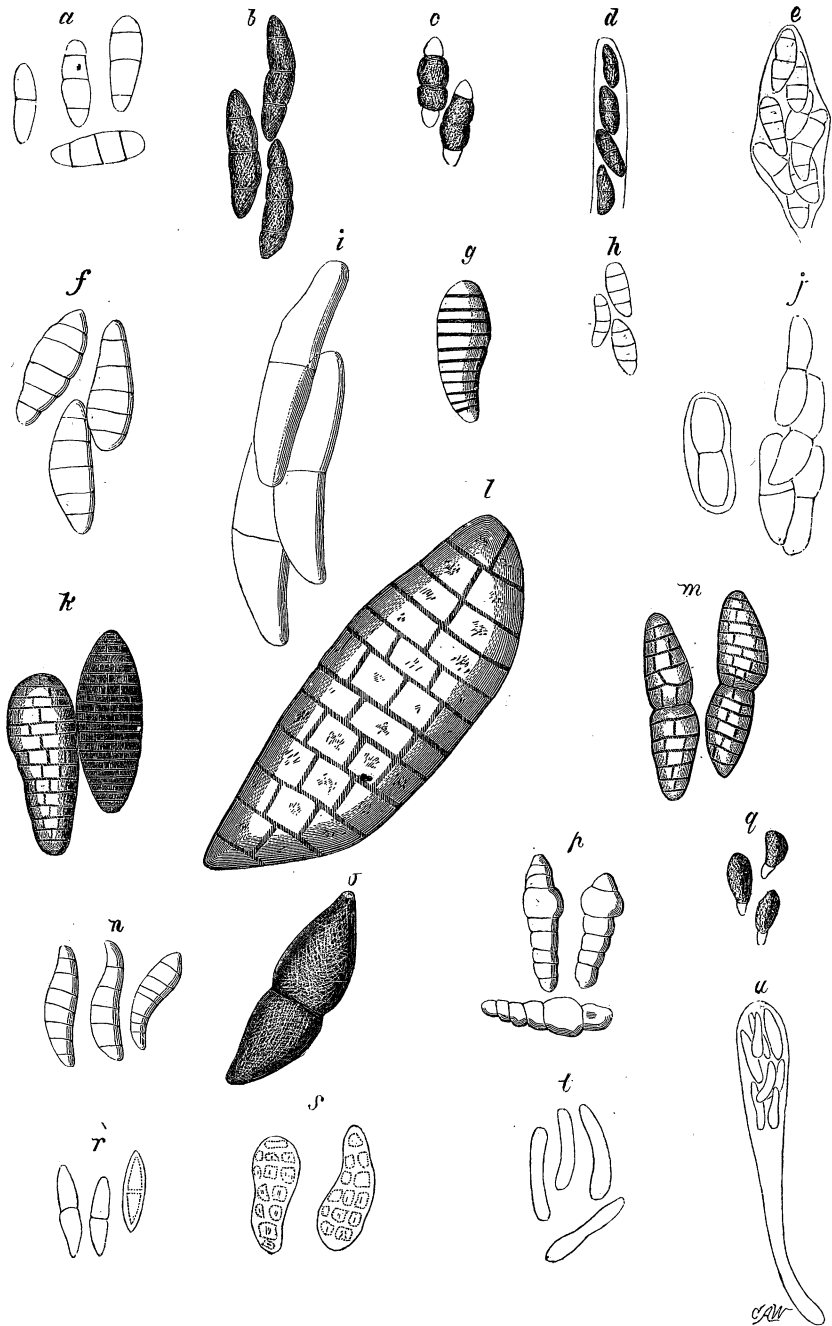
BY DR. J. S. BILLINGS, U.S.A.

My purpose in the following paper is to enable those who are commencing the study of mycology, but who have not access to authentic specimens and to the greatly scattered and often contradictory literature of the subject, to identify the common species of the genus *Hysterium* and its closely allied forms. My data for this purpose are derived from the examination of authentic specimens in the Schweinitz Herbarium, and in the herbarium of Mr. H. W. Ravenel of South Carolina; from specimens named by Rev. M. A. Curtis, and from the description and figures given by M. Duby in his "*Mémoire sur la Tribu des Hystérinées*," Geneva, 1861.

The genus *Hysterium* is one of the Ascomycetous forms of fungi characterized by the peculiar shape and mode of opening of its conceptacle or perithecium,* which is either elliptical or longitudinal, opening by a slit or fissure running in the direction of its greatest length.

The species are found upon dead wood, bark, leaves and stems

*For explanation, with figures, of the parts of fungi, see NATURALIST, vol. iv. p. 667-674.



BILLINGS ON THE GENUS HYSTERIUM.

in the shape of black specks or crusts which, under a lens, will be seen to be small, boat-shaped bodies with a vulvæform fissure looking like minute grains of black wheat. When developed in or on wood, their structure is usually carbonaceous and brittle. When developed beneath the epidermis of leaves or herbaceous stems, the perithecium is usually thin and membranaceous, and more or less connate with the surrounding structures.

The difference in fruit is also well-marked and hence these latter forms will be referred to the genus *Hypoderma*.

For the identification of the species of this genus in the present state of our knowledge, we must rely mainly upon the size, shape, structure and color of the spores, and hence a few words are necessary with regard to the morphology of the spore. Spores vary according to age and some other circumstances in all the points upon which we rely. Thus the same spore at different periods may be colorless or very dark colored, uniseptate or multiseptate, fusiform or obovate, and from .0005 to .002 of an inch in length.

The limits of this variability are not precisely known, but the student may be guided somewhat by the fact that the development of spores and asci is not everywhere simultaneous in the same perithecium. When in any ascomycete we find the perithecium fully developed, and all the spores apparently equally mature—for instance, all yellow brown, triseptate and varying not greatly in form and size,—we are justified, I think, in concluding that these spores are mature.

If, on the other hand, we find that some of the asci do not contain spores, but merely the mass of greenish colored protoplasm which by segmentation will ultimately form them, while other asci contain greenish spores the contents of which are divided into two or four parts—and in none do we find colored or clearly septate spores—we may consider the specimen as immature.

The peculiar greenish hue of the spore, to which I have alluded, seems to indicate that it is an immature state of a yellow or brown spore, while a white, perfectly colorless or hyaline spore may be in itself a perfect form. In the examination of specimens which have been for some time in an herbarium, we should expect to find the spores mostly mature, as in the first place it is to be presumed that only the more perfect specimens would be thus preserved, and secondly, the perfecting and ripening of immature spores will go on, even in the herbarium, to some extent.

Again it must be remembered that the classification of the genus *Hysterium* must be as yet provisional, not being based at all upon the only real test of a true species, *viz.*, the propagation of its kind. But before we can attempt the true physiological classification of such forms, we must have some sort of division of them that we may know what we are talking about. In this point of view it is evident that we want to name as many forms as possible to avoid confusion, and that two different forms should not receive the same name unless the observer is very certain as to their identity. To explain my meaning more fully I will take the case of one of the commonest forms among the Ascomycetes, *viz.*, *Hysterium pulicæ* Pers. The description of this species, as given by Persoon, Fries and the older mycologists, is entirely insufficient to enable us to identify it, and we must have recourse to authentic specimens to know positively which form the older authors placed under this head. The spores shown in fig. *a* of plate 11 were drawn from a specimen in the Schweinitz herbarium received from Fries as a type specimen. Another specimen from Fries, marked *B. lenticulare* has the same kind of spores. A specimen from the *Scleromycetes Suiciæ* in Mr. Ravenel's herbarium has somewhat larger spores which are obovate, triseptate and very dark brown. Duby states as the result of the examination of authentic specimens that the spores of *H. pulicæ* are oblong, two or three times longer than wide, triseptate, clear brown, or with the terminal loculi colorless. When young the spores are 1-septate and hyaline.

Corda figures the spores in like manner. On the other hand, I find in one specimen named by Kunze, and in specimens named by Berkeley, Curtis and Ravenel, that the spores are much larger, darker, more opaque, with longitudinal septa and obovate or pyriform, in short, like the fruit of *H. elongatum*. (Pl. 11, fig. *k*). The authors last named consider the above as belonging to *H. pulicæ* for the reason that in one perithecium, resembling those of that species, they find spores varying from the short, colorless, uniseptate form, to those described above. It is of course possible, and perhaps not improbable, that the large cellular spores are the fully developed fruit, but on the principles stated above (as I find in the majority of authentic specimens that all the spores present an equal development and yet have a simpler form), I prefer to consider that form as the perfect type and refer the others to *H. elongatum*.

It will be observed that I have taken no note of the minor differences which the perithecia present.

An examination of many varieties and specimens has shown that in *H. pulicare*, for instance, the perithecia may be long or short, wide or narrow, striate or smooth, with lips thin or thick and more or less gaping, the variations appearing to depend on the kind of wood, the age of the specimen, and the amount of heat, light and moisture to which it has been subject, and hence such characteristics are of little relative value.

It is supposed that besides the ascous form, *Hysterium* has other modes of manifestation; for instance, Tulasne affirms that *Leptostroma vulgare* is a form of *Hysterium herbarum*; the argument being the usual one of *post hoc ergo propter hoc*, that is, *Hysterium herbarum* has been found either coincident with, or immediately succeeding to the *Leptostroma* on the same matrix. As I have elsewhere insisted, the only way to settle this question is by culture of the various forms upon different matrices.

The germination of *Hysterium* spores goes on very well in an ordinary growing slide, and the results are very interesting, especially in regard to those species with cellular spores, in which each loculus gives rise to a mycelial filament. I have several times observed a connection formed between neighboring filaments, resembling very much the sexual process as it occurs in some algæ, but as yet am not prepared to say that it is of a sexual nature. I recommend the subject for observation and experiment to those who have microscopes and no definite work on hand for their instruments.

The best classification of the *Hysteriacei* is that of M. Duby, but I think he has been premature in his effort to construct half a dozen new genera. The old division of *Lophium*, *Glonium*, *Actidium* and *Hysterium* serves well enough for identifying purposes, although as stated in the commencement of this paper, those forms of *Hysterium*, with thin membranous perithecia found in leaves and herbaceous stems, may be conveniently referred to the subgenus *Hypoderma*.

The data are yet wanting for a revision of this family with a view to indicating their relations to other fungi and to each other.

The accompanying plate gives the figures of the spores of the common forms of *Hysteriacei* magnified five hundred diameters. Fig. 1 represents a very large spore from a specimen in Mr. Rav-

enel's herbarium, marked *H. depressum* B. and C. Other spores in the same specimen were one-fourth less in size. With these figures and the following brief synopsis, there will be little difficulty, I think, in identifying the usual forms.

HYSTERIUM.

- A. Spores simple, colorless, minute (*Aporia* of Duby).
 1. *Hysterium herbarum* Fr. Spores minute, colorless, globose. (Sp. ex. Fr. in Schw. Herb.)
 B. Spores filiform, colorless or greenish, lying side by side in bundles, often apparently without an investing sheath or ascus. (*Lophodermium*, *Sporomega*, *Coccomyces* and *Colpoma* of Duby.)
 2. *H. pinastri* Schrad.
 3. *H. arundinacearum* Schr.
 4. *H. melaleucum* Fr.
 5. *H. maculare* Fr.
 6. *H. tumidum* Fr.
 7. *H. foliicolum* Fr.
 8. *H. griseum* Schw.
 9. *H. variegatum* B. & C.
 10. *H. rhois* Schw.
 11. *H. rhododendri* Schw.

A number of additional species are enumerated in this connection by M. Duby, but I give only those which I have examined. The structure and relations of this group are very obscure. Some of them are almost certainly immature or aborted forms, and science would lose nothing if the whole were reduced to *H. arundinacearum* and *H. foliicolum*.

- C. Spores simple, colorless, elongate, often curved and sausage-shaped.
 12. *H. rubi* Pers. Spores colorless, .0015 inch long. (Fig. 20.) (Spec. ex Kunze in Schw. Herb.)
 13. *H. scirpinum* Fr. Spores colorless, .0018 inch long. (Sp. ex Fr. in Schw. Herb.)
 14. *H. corni* Schw. Spores rod-like, straight, .002 inch long. (Spec. ex Kunze in Schw. Herb.)
 15. *H. rufescens* Schw. Spores subfusiform, colorless, .0005 inch long, in long clavate asci.
 D. Spores uniseptate.
 16. *H. smilacis* Schw. Spores colorless, subpyriform, .001-.0013 inch long, with a gelatinous envelope when young. (Fig. 10.) (*H. Curtisii* Duby, is probably the same.)
 17. *H. varium* Fr. Spores brown, opaque, fusiform, subacuminate, .003 inch long.
 18. *H. lineare* Fr. Spores colorless, ovoid or obovate, sometimes constricted in the middle, .0005 inch long.
 19. *H. repandum* Blox. Spores at one end elongate and hyaline, the rest dark brown, .0006-.0007 inch long. (Fig. 17.)
 E. Spores triseptate.
 20. *H. pulicare* Fr. Spores dirty brown, terminal loculi often clearer or colorless, .0009 inch long.
 21. *H. betulignum* Schw. Spores brown, .0008 inch long.
 22. *H. tortile* Schw. Spores brownish, obovate, .0006 inch long.
 23. *H. flexuosum* Schw. In the specimen in the Schweintz Herbarium, the spores in the distinctive flexuose perithecia are identical with those of *H. pulicare*. In some straight short perithecia the spores are cellular, .0015 inch long.
 24. *H. bifforme* Fr. Spores yellow brown, .001-.0012 inch long, sometimes constricted at the septa or torulose.
 25. *H. Prostii* Duby. Spores brownish, subpyriform, .0065 inch long.
 26. *H. rufulum* Fr. (*Triblidium* of Sprengel.) Spores at first reddish brown, afterwards dark, .001-.0014 inch long.
 F. Spores multiseptate, or cellular.
 27. *H. acuminatum* Fr. Spores curved, yellow, multiseptate, obtuse or subacuminate, .001-.0013 inch long.
 28. *H. insidens* Schw. Spores dark yellow brown, 5-7 septate, .0011 inch long; third or fourth joint swollen.
 29. *H. Mori* Schw. Spores dark yellow brown, curved, subpyriform, multiseptate, .001-.0013 inch long.
 30. *H. teres* Schw. Spores yellow, 3-5 septate, .0008-.0012 inch long.
 31. *H. fraxini* Pers. Spores dark brown, elliptic or subpyriform, cellular, .0015 inch long. (Spec. ex Kunze.)
 32. *H. prelongum* Schw. Spores yellowish, broadly obovate, cellular, .0012 inch long.
 33. *H. vulvatum* Schw. Spores dark, nearly opaque, constricted in the middle with distinct septum, .0015-.002 inch long, each half cellular.
 34. *H. elongatum* Wulfr. Spores dark brown, obovate or subpyriform, cellular, .001-.002 inch long. (Spec. ex Fries.)
 35. *H. depressum* B. & C. Spores dark, opaque, brown, cymbiform, cellular, with central distinct septum, like *H. vulvatum*, .003-.0045 inch long. (Spec. in Rav. herb. ex Curt.)

36. *H. decipiens* Duby. Spores straw color, obovate or elliptical, .001 inch long, 4-5 septate, with one or two longitudinal septa.
 37. *H. Lesquerewatii* Duby. Spores brownish, ovate oblong, constricted in the middle, obtuse, 6-7 septate, with longitudinal septa.
 38. *H. funereum* DeNot. Spores ovoid or oblong, 4-7 locular, with one or two longitudinal septa, four times as long as broad, clear, brownish. (Duby.)
 39. *H. complanatum* Duby. Spores linear lanceolate, acute, 3-5 septate, not constricted, reddish brown.
 40. *Hysterium verbasci* Schw. Spores colorless, subpyriform, often curved; endochrome multipartite, .001-.0015 inch long.
 41. *H. latinum* Pers. Spores like *H. verbasci*.
 42. *H. rimicola* Schw. Spores colorless or greenish, multipartite, obovate, .001 inch long or more.
 43. *H. virguliform* Desm'g. Spores colorless, curved rods indistinctly 4-5 septate, .0005 inch long.

Species which should be rejected as not belonging to the genus, or as having no fruit, and therefore not to be identified:—

- H. abbreviatum* Schw. Spec. in Schw. Herb. is an immature *Sphæria*.
H. polygonati Schw. Sp. in Schw. Herb. has no fruit.
H. oxycoccus Fr. Sp. ex Fr. has no fruit. Duby found no fruit in authentic specimens.
H. osmundæ Schw. Sp. in Schw. Herb. is a *Septoria*.
H. naticola Schw. " " " " has no fruit.
H. librincola Schw. " " " " is a *Hendersonia*.
H. kalmiæ Schw. " " " " has no fruit.
H. syringæ Schw. " " " " " " "
H. sphaeroides A. S. " " " " ex Fr. no fruit. Duby found no fruit in authentic specimens.
H. castanæ Schw. Spec. in Schw. Herb. has no fruit.
H. Andromedæ Schw. " " " " " " "

The following species are rejected by Duby.

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|----------------------------|------------------------------|
| <i>H. abietinum</i> Pers. | <i>H. strineforme</i> Walls. |
| <i>H. parallelum</i> Wahl. | <i>H. samcorum</i> Larch. |
| <i>H. rubrum</i> Fr. | <i>H. pithyrum</i> Kunze. |
| <i>H. cocciferum</i> Cast. | <i>H. minutum</i> D. C. |
| <i>H. oleæ</i> Cast. | |

DESCRIPTION OF PLATE 11.

- Fig. a. Spores of *Hysterium pulicare* Pers.
 " b. " " " *biforme* Fr.
 " c. " " " *tëres* Schw.
 " d. " " " *tortile* Schw.
 " e. Ascus and spores of *Hysterium flexuosum* Schw.
 " f. Spores of *Hysterium frazzini* Fr.
 " g. " " " *mori* Schw.
 " h. " " " *Prostii* Duby.
 " i. " " " *chlorinum* B. & C.
 " j. " " " *smilacis* Schw.
 " k. " " " *elongatum* Fr.
 " l. " " " *depressum* B. & C.
 " m. " " " *vulvatum* Schw.
 " n. " " " *acuminatum* Fr.
 " o. " " " *varium* Fr.
 " p. " " " *insidens* Schw.
 " q. " " " *repandum* Blox.
 " r. " " " (*glonium*) *graphicum* Fr.
 " s. " " " *verbasci* Schw.
 " t. " " " *rubi* Fr.
 " u. " " " *rufescens* Schw.